

Interactive sonification of German wheel sports movements

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1 Abstract

This paper presents the design, implementation and evaluation of a sonification system, which gives real-time auditory feedback to a performer who is carrying out moves on sports equipment called a German wheel. The paper starts with a brief description of different German wheel move categories and of relevant research on movement sonification to present how these motivated some of our design decision. Thereafter the structure and functionality of the sonification system, which is implemented in the programming language SuperCollider is discussed, including its division into three sub-tasks. These sub-tasks are data acquisition, feature extraction and sonification.

The data acquisition uses a magnetometer to collect data about the motion of the wheel. By measuring the magnetic field of the earth, it acts similar to a compass and allows to determine the orientation of the wheel. This orientation is one of the main features that are derived from the input data in the feature extraction process. A set of further features is derived from the input data and the orientation of the wheel. The choice of these features was inspired by the background knowledge about the different wheel move categories and accordingly the task a performer who is using the wheel is confronted with. Finally the system uses the features to produce an acoustic representation of the motion. We implemented four different sonifications: the Direct-data sonification, Cartoonification, Vowel synthesis sonification and Event-based sonification.

The Direct-data sonification uses the unprocessed input data to generate an acoustic feedback, which leaves the interpretation completely to the user. The Cartoonification uses some of the features to imitate and amplify a natural rolling sound. The Vowel synthesis represents the motion of the wheel through synthetic vowel sounds. The idea is based on the thought that

due to the use of language the human sound processing system is highly adapted to such sounds. The Event-based sonification uses the fact that sound is highly suitable to represent time dependent patterns and the ability of the human auditory perception to recognise the resulting rhythms. It produces sound events every time the features fulfil certain conditions. Due to their highest adaptation to the task of the performer, the Vowel synthesis sonification and Event-based sonification were chosen to conduct an exempla study, whose aim was to indicate whether such additional auditory feedback can lead to an improved skill learning of a performer on the wheel. The study was carried out with a group of seven novices and four experts and shows a significant positive influence of the Event-based sonification on the performance of the given task by the experts. (See Figure 1 for an image of the interface that was used during the experiments and their evaluation.)

An interaction example is provided online at [5]

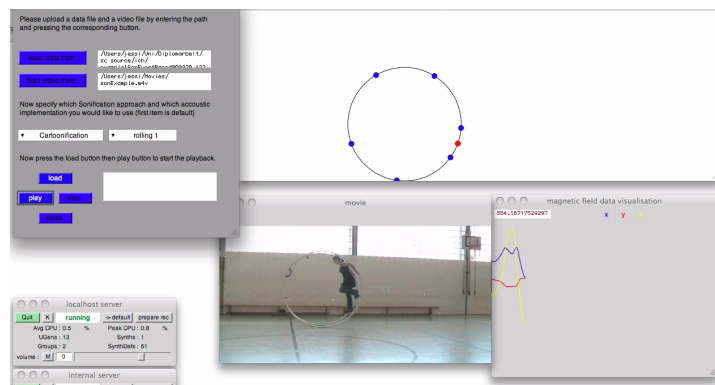


Figure 1: Interface used for the analysis of data that was collected during experiments with the interactive real-time sonification system. A video of the performer on the wheel is played (middle) together with the sonification. Additionally the model of the wheel’s orientation (top right) and a visualisation of the original input data (bottom right) are shown.

References

- [1] A. Effenberg, J. Melzer, A. Weber, and A. Zinke. MotionLab Sonify: A Framework for the Sonification of Human Motion Data. *Information Visualisation, 2005. Proceedings. Ninth International Conference on*, pages 17–23, 2005.

- [2] A.O. Effenberg. Movement Sonification: Effects on Perception and Action. *IEEE MULTIMEDIA*, pages 53–59, 2005.
- [3] T. Hermann, O. Honer, and H. Ritter. Acoumotion-an interactive sonification system for acoustic motion control. *Gesture In Human-Computer Interaction and Simulation–6th International Gesture Workshop, (GW’2005), Berder Island, France*, 2005.
- [4] J. Hummel, T. Hermann, Fr, and T. Stockman. Interactive sonification for monitoring and skill learning. Master’s thesis, Bielefeld University, Ambient Intelligence Group, CITEC - Center of Excellence in Cognitive Interaction Technology, 2009.
- [5] C. Frauenberger J. Hummel, T.Hermann and T. Stockman. Example sonifications for ”Interactive sonification of German wheel sports”. <http://sonification.de/publications/HummelHermannFrauenbergerStockman2010-ISO>.